
***New Zealand's Centre for Excellence in Power:***

***The Electric Power Engineering Centre***

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## SYNOPSIS

Since the launch of the Electric Power Engineering Centre (EPECentre or EPEC) in June 2002, with the support of New Zealand's electric power industry via the Power Engineering Excellence Trust (PEET), future prospects for power engineering in New Zealand are looking extremely positive. The EPECentre has been involved in facilitating and implementing a host of programmes, activities, and initiatives, including various field trips, onsite lectures, visiting lecturer programmes, premium scholarships, conferences, conventions, expos, market research, and work placement/graduate recruitment in the power industry. These have resulted in increased student enrolments in power courses in the Department of Electrical and Computer Engineering at the University of Canterbury (UC) for four consecutive years (2003-2006), since the inception of EPEC. There are now about twice as many students enrolled in power courses as compared to 2002, i.e. from as little as 14 students in 2002, to 34 in 2006 – an increase of over 140% in 4 years.

Consequently, this has led to a renewed interest in power engineering research and innovation in New Zealand. The EPECentre has now become the focus point for this new directive, with the launch of New Zealand's first electric power engineering research and development programme in April 2005. The EPECentre is now focused on the facilitation and implementation of collaborative industry-academia research and development (R and D), *'a win-win for both academia and industry'*, while continuing with its successful initiatives to boost the quantity and the quality of power engineering graduates in New Zealand.

## 1. INTRODUCTION

The Electric Power Engineering Centre (EPECentre or EPEC) is New Zealand's first Centre of Excellence for power engineering. It was launched in June 2002 with the support of New Zealand's electric power industry, via funding generated through a Trust, called the Power Engineering Excellence Trust (PEET).

The aim of the EPECentre is to promote and support power engineering excellence in New Zealand. It is focussed on bringing fresh minds and perspectives to New Zealand power engineering through student-industry interaction, enabling awareness of and planning for future industry challenges. It is working to encourage greater numbers of students into power engineering courses in the Department of Electrical and Computer Engineering (ECE) at the University of Canterbury (UC), to establish stronger relationships between students and the industry, to increase the quality and quantity of power engineers in New Zealand, and to create and foster power engineering innovation and research. To achieve its aims, EPECentre offers a number of support programmes in several areas including scholarships, practical work, research, mentoring and extramural-training.

## 2. GOALS OF THE EPECENTRE

The stated goals that are used as a guideline to determine specific activities undertaken by the EPECentre are:

- To encourage greater numbers of students into power engineering courses at the Department of Electrical and Computer Engineering, University of Canterbury, maintaining sustainability of power engineering courses.
- To create a stronger and closer relationship between power engineering students and the power industry.
- To create and foster power engineering innovation in New Zealand.
- To attain a greater level of interaction between academic staff and the power industry.
- To provide better visibility of power engineering courses to industry and improved opportunity for industry input into courses.
- To increase the quantity and quality of power engineering graduates in New Zealand.
- To maintain and enhance power engineering education and research within the Department of Electrical and Computer Engineering, University of Canterbury.

## 3. CENTRE PROGRAMMES AND EVENTS

To achieve the goals of the EPECentre, a number of activities have been introduced. These are aimed at bridging the gap between students studying at university and the power industry as future employers.

- Field trips to power stations, large consumers and systems operational centres in both the North and South islands.
- Convention – a series of presentations from industry companies outlining what their companies do and the career opportunities they offer.
- R and D Expo – a laboratory based display of electric power research and development projects undertaken within ECE as a means of exciting able students to consider taking higher Masters and PhD research degrees. These projects are often supported by power companies.
- Graduate recruitment – the EPECentre acts as an intermediatory between the power companies offering employment and students wanting their first job.
- Practical work placement – students are required to undertake 120 days of employment in engineering companies as a mixture of mechanical and electrical workshop and professional practice, as part of their degree requirements. Over 150 placements have been made since 2002.
- Guest lecturers/ Visiting lecturer programme – The EPECentre has had a number of overseas academics and industry engineers to broaden the base of material offered in lectures and to bring best practice and relevancy to electric power teaching.
- Scholarships (PostGrad/Undergrad) – 10 undergraduate scholarships of NZ$5000 are offered each year to good students electing to take power engineering subjects in their ECE degree. This is augmented by the same number of targeted scholarships directly offered by some companies who also give practical work placement and post-degree employment. A number of post-graduate scholarships are also offered for research.
- Surveys – these obtain information from students as to their desires, perceptions and aspirations regarding electric power engineering and help determine future directiond for the EPECentre.
- Onsite lectures – ECE academics arrange lectures on power station sites to illustrate theory with practical displays of transformer and generator refurbishment and testing.
- Laboratory upgrade – industry has supported the procurement of new equipment for the undergraduate machines laboratory. This has allowed a better match between lecture material and laboratory practice through multiple machine sets rather than students cycling through experiments that were equipment constrained.
- Research support – a number of academic research projects have received significant funding from companies to develop technology, e.g. superconducting transformer, system studies, renewable energies.
- Marketing engineering careers in schools – a DVD portraying electric power engineering is distributed to schools. High voltage laboratory demonstrations to school groups are the highlight of open days.

- Media releases are made to increase public awareness of any significant achievements and activities
- Presentations are made on research at national and international conferences along with publication of achievements in international journals.
- A Quarterly e-Bulletin is distributed to an e-list of some 300 engineers, CEOs and associates, both within NZ and to a number of international contacts and colleagues.
- Technical workshops and Professional development events are organized on specific topics, often in collaboration with other engineering and academic organizations.
- Collaborative industry-academia R and D is undertaken under contract, with the EPECentre offering project management and technical expertise unavailable elsewhere. Wind solar energy systems deployed in Antarctica and energy efficient lighting studies are but two examples.

## 4. THE POWER REVIVAL

The successful EPECentre initiatives of the past four years have led to a significant increase in student numbers as shown in Table 1 and Figures 1-4 for course intake comparisons of power students in the Electrical and Electronic degree programme at the University of Canterbury 2000-2006.

***Table 1. University of Canterbury enrolment data for all power courses 2000-2006***

***Note 1:*** *the cell colour coding in Table 1 indicates the same stock of students going through the three consecutive years of the 1st, 2nd, and 3rd Pro Electrical and Electronic Engineering Degree. The colour coding can also be used to highlight dropouts/failures, and direct entry students for each batch as they progress through the three professional years.*

| | Pre EPECentre | | | Post EPECentre | | | |
|---|---|---|---|---|---|---|---|
| ***Academic Year*** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** |
| **Total enrolled for 1st Pro.** | **95** | **106** | **107** | **81** | **108** | **110** | **82** |
| Electrical Systems 1st Pro. (Compulsory) | 95 | 106 | 107 | 81 | 108 | 110 | 82 |
| *% (# of enrolled students for course above / (total enrolled 1st Pro.)* | *100%* | *100%* | *100%* | *100%* | *100%* | *100%* | *100%* |
| **Total enrolled for 2nd Pro.** | **113** | **94** | **99** | **106** | **97** | **105** | **108** |
| Power Electronics 2nd Pro. | 89 | 46 | 60 | 52 | 41 | 65 | 76 |
| *% (# of enrolled students for course above / (total enrolled 2nd Pro.)* | *79%* | *49%* | *61%* | *49%* | *42%* | *62%* | *70%* |
| Electric Power Engineering 2nd Pro. | 41 | 20 | 26 | 37 | 38 | 45 | 42 |
| *% (# of enrolled students for course above/ (total enrolled 2nd Pro.)* | *36%* | *21%* | *26%* | *35%* | *39%* | *43%* | *39%* |
| **Total enrolled for 3rd Pro.** | **119** | **105** | **87** | **99** | **99** | **75** | **88** |
| Power Electronics 3rd Pro. | 44 | 49 | 23 | 41 | 38 | 30 | 49 |
| *% (# of enrolled students for course above / (total enrolled 3rd Pro.)* | *37%* | *47%* | *26%* | *41%* | *38%* | *40%* | *56%* |
| Power Systems 3rd Pro. | 21 | 29 | 14 | 24 | 28 | 35 | 34 |
| *% (# of enrolled students for course above / (total enrolled 3rd Pro.)* | *18%* | *28%* | *16%* | *24%* | *28%* | *47%* | *39%* |
| Power Engineering Applications 3rd Pro. | 15 | 25 | 16 | 21 | 28 | 35 | 34 |
| *% (# of enrolled students for course above / (total enrolled 3rd Pro)* | *13%* | *24%* | *18%* | *21%* | *28%* | *47%* | *39%* |

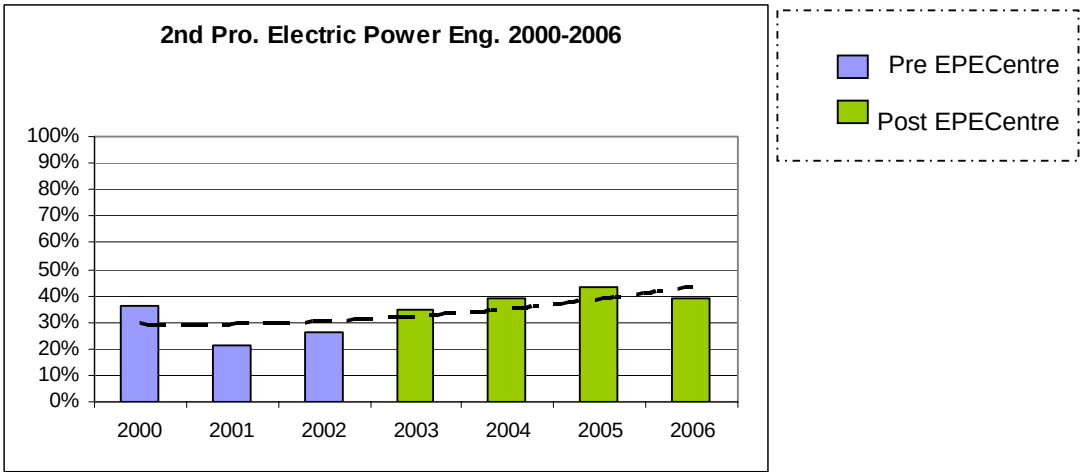


*Figure 1. 2nd Pro Electric Power Engineering enrolments 2000-2006*

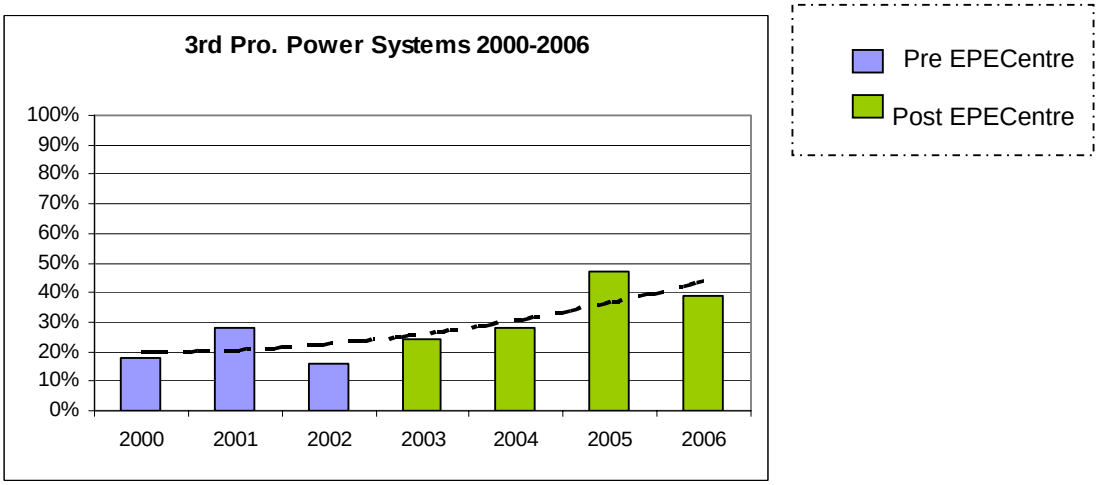


*Figure 2. 3rd Pro Power Systems enrolments 2000-2006*

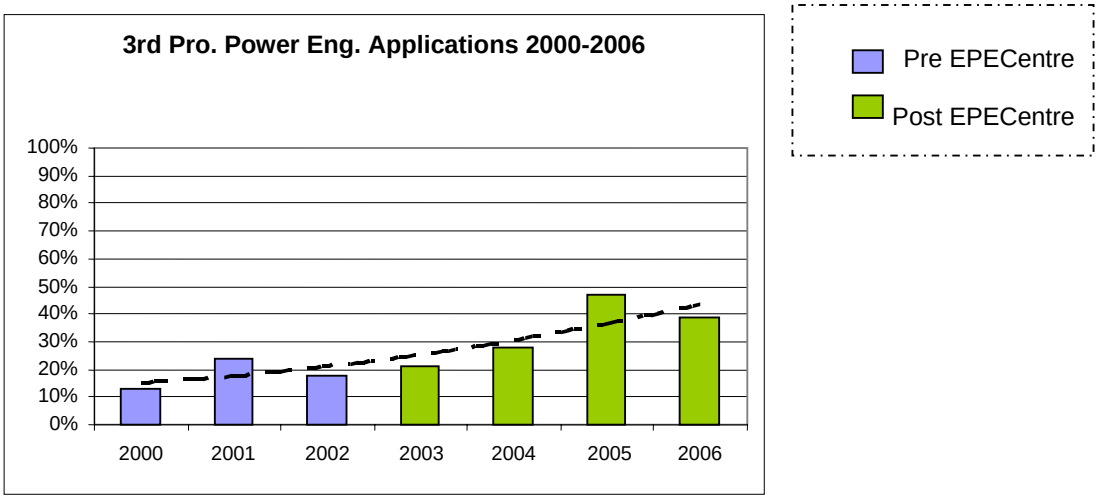


*Figure 3. 3rd Pro Power Engineering Applications enrolments 2000-2006*

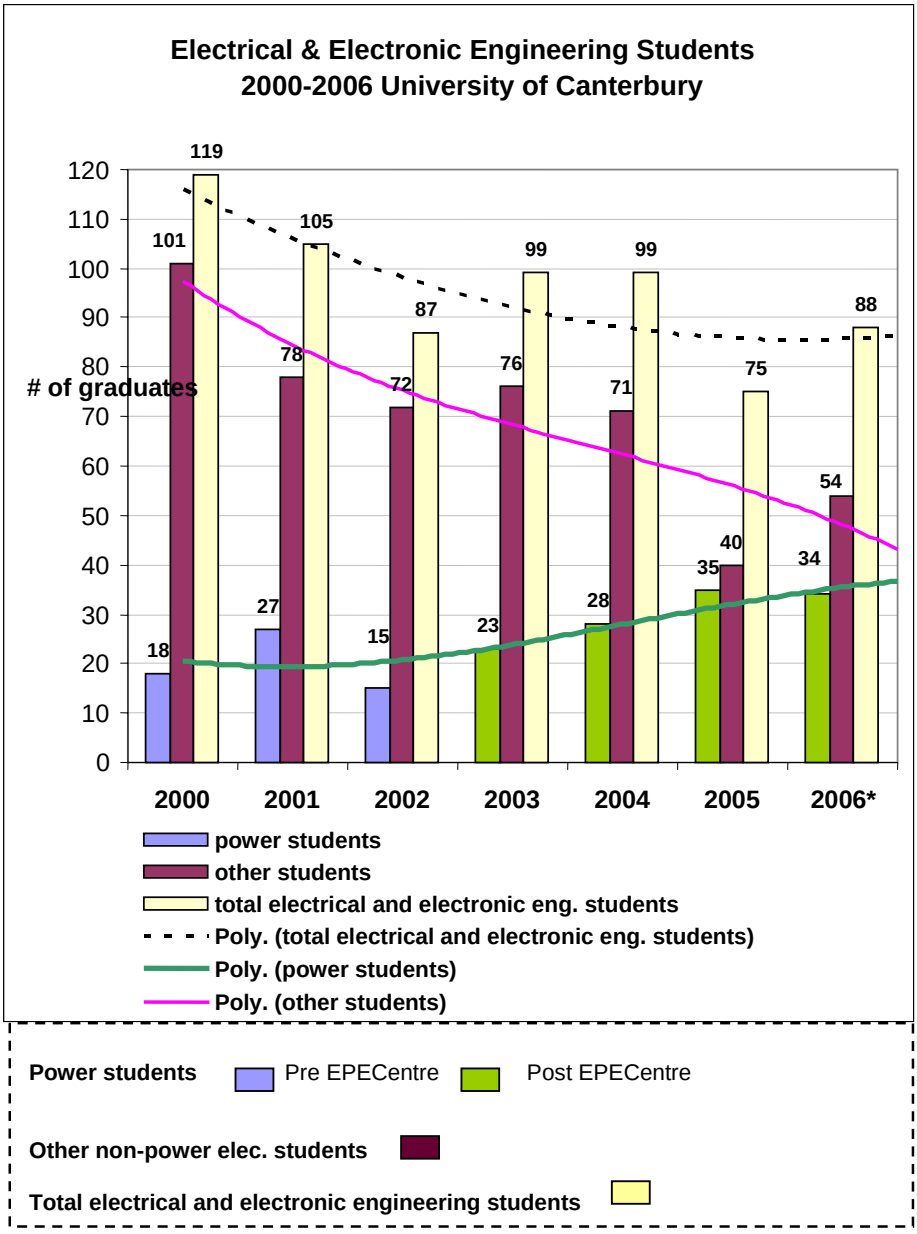


***Figure 4. Power student numbers compared to all non-power electrical engineering students 2000 – 2006.***

Specialist power students are defined for the purposes of this paper as students that take 3rd Pro Power Systems and 3rd Pro Power Engineering Applications. The graph excludes 3rd Pro. Power Electronics for clarity, as this is seen as a course that is common to many electrical engineering disciplines, including power. Student numbers are averages based on enrolment numbers for 3rd Pro Power systems and Power Engineering Applications courses depicted in Table 1.

The EPECentre was launched in mid 2002, therefore it had no effect on student enrolments until the new academic year of 2003. The data presented in Figures 1-4 convey the notable changes between enrolments pre-EPECentre 2000-2002 and post-EPECentre 2003-2006.

**Key Observations:**

- The pre-EPECentre era (prior to 2003) had significantly low rates of intake for power courses at the University of Canterbury
- The post-EPECentre era (2003 onwards) has resulted in a significant increase in power enrolments, over four consecutive years (2003-2006).
- The gap between students with power background and non-power background is narrowing, since the inception of EPECentre
- The total number of eligible students to take 3rd pro power engineering in 2006 was 38. This was because, in 2005, 38 out of 45 enrolled passed 2nd Pro power engineering (pre-requisite for 3rd pro power), i.e. 90% of students eligible to do 3rd pro power engineering are doing power engineering in 2006. This is a 90% hit rate.
- 47% (35) of all electrical and electronic engineering students in 2005 can be classified as power engineers. Notably, this gave the largest influx of potential power graduates into the New Zealand industry for at least the last 6 years.
- Class-sizes (i.e. number of students) of a number of power engineering courses are over twice as big as they use to be, e.g. 3rd Pro. Power Systems grew from 14 students in 2002 to 35 in 2005, a 150% increase in class size in 3 years.
- An area for concern is the reduction in the number of electrical and electronic engineering students in general. The average intake over 2000-2006 is 100 students per year, however, 2005 and 2006 show a decline from previous years. This is an issue the EPECentre will attempt to tackle in the coming years, additional to any action taken by the ECE department and the university.
- Power engineering students entering 2006 remain steady, as in 2005 (following the growing upward trend since the launch of the EPECentre).

During the Pre-EPECentre era (2000-2002 in Figures shown), a pattern emerges that indicates that students took 2nd Pro Electric Power Engineering (almost as a filler course), with students discontinuing with power in their final 3rd Pro year (an average of 30% discontinued with final year power between 2000 and 2002). The pattern has improved in the post-EPECentre era with an average of 13% discontinued with final year power between 2003 and 2006

The average number of electrical and electronic engineering graduates per year is approximately 100, with an average of 20 specialist power graduates per year during the pre EPECentre era (2000-2002). This has grown to an average of approximately 29 power graduates per year between 2003 and 2006 (post EPECentre era) – that implies an addition of 9 'more' power graduates entering New Zealand industry each year.

**The prediction:**
Over the long-term, the number of power graduates should level off at around 30-40 graduates per year, based on current enrolment trends at the University of Canterbury.

**Important Observation - *not apparent in data:***
Power is now attracting a significant number of the top echelon of achievers in each academic year, i.e. a large proportion of high caliber students are choosing power as a career option.

**Reaching the Prediction:**
Sustained industry support is required to continue with the success of the EPECentre, and to facilitate the introduction of newer and more innovative programmes and activities to win future student interest. An area that requires particular attention is electric power engineering research and development (R and D), which should help boost and maintain student interest and graduate numbers in power, as well as provide many synergistic benefits for both industry and academia.

## 5. THE MAGIC OF R AND D

Industry-academia collaborative Research and Development (R and D) is beneficial to both industry and academia. A selected list of the benefits includes:

**Industry:**

- Get problems solved that cannot be tackled because of a lack of resources/outside core business/technical expertise/time limitations.
- Opportunity to develop commercially viable value-added solutions, and or innovative technology and/or spin-offs with commercial benefits, and/or gain competitive advantages.
- Involvement means promotion of individual organisations to potential future employees.
- Makes university degree content and educational experience more relevant for industry.

**Academics:**

- Active interaction with industry, which is also advantageous for advancement within the ranks of the academic sector.
- Opportunity to gain funding for innovative ideas (with commercial benefits).
- Salary boosts and prestige - working on funded research projects means income top-ups, as salaries in the academic sector are below industry rates.

**Students:**

- Incentive to follow a career in power that is revived and showing signs of new technological development and innovation as a result of collaborative research.
- Opportunity to work on relevant industry projects that have applied outcomes.
- Opportunity to impress and possibly gain graduate employment and to pursue postgraduate study by working on relevant industry projects.
- Encourages the suitable few to consider the academic career path – a 'vital' area that is currently in decline, as a looming shortage of academics draws near.
- Incentive to stay in New Zealand after graduation, i.e. they will begin to see future opportunities and a strong local industry support base.

**Action Plan:**

To further develop collaborative electric power R and D in New Zealand and establish lasting success for New Zealand's Centre for Excellence in Power, a number of new initiatives and directions are envisaged.

- Individual industry organisations or groups of industry sectors to develop a 'wish list' of key problem or opportunity areas facing individual organisation and/or industry sectors e.g. generation sector.
- Communicate the issues relating to each industry sector issue and or individual organisation issue to the EPECentre.
- Develop and shape projects around the issue(s).
- The EPECentre develops a project plan (including resources (personnel and equipment), timelines, and budgets) to tackle the issue in coordination with the organisation(s) concerned or with representatives from the concerned industry sector, e.g. lines companies.
- Establish funding routes to undertake project(s), either in the form of individual organisational funding, joint organisational funding, and/or group sector funding, as well as investigate options for government funding.
- The industry project partners play an advisory support role during the course of each project, knowing that the work is being conducted professionally, and to the highest industry standard.
- The EPECentre draws on a wide range of technical expertise from within the University of Canterbury and other external international institutions (through its network) to enable multidisciplinary research and development.

- The centre employs a fulltime Manager and several R&D Engineers on a project by project basis.

The EPECentre has already initiated a number of collaborative projects with New Zealand industry, including a 12 month joint project with Orion NZ and Enermet Limited to research flicker issues on distribution networks, and a MOU with Antarctica New Zealand to research renewable energy options for Antarctica, as well as conducting R and D on the worlds first partial-core high temperature superconducting (HTS) transformer in partnership with Meridian Energy.

## 6. CONCLUSIONS

Since the inception of the Electric Power Engineering Centre in 2002, there has been a dramatic turnaround in enrolments for power engineering courses at the University of Canterbury (for four consecutive years). Furthermore, approximately 50% of all electrical and computer engineering graduates in 2005 were specialist electric power engineers, which represents one of the largest influxes of power graduates into New Zealand industry for at least the last 6 years. The future prospects for power engineering in New Zealand are looking extremely positive.

Consequently, this has also lead to a renewed interest in power engineering research and innovation in New Zealand. The EPECentre has now become the focal point for this new directive, with the launch of New Zealand's first electric power engineering research and development programme in 2005.

The EPECentre is now focused on the facilitation and implementation of collaborative industry-academia research and development (R and D), an area that will provide synergist benefits for both academia and industry.

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